

Study on Influencing Factors of Tourism Income in Yantai City Based on Multiple Linear Regression Analysis

Yue Guan*, Meng Tian, Li Wang

Hengxing University, Qingdao 266000, China

*Corresponding author: Yue Guan, g2978762621@163.com

Copyright: © 2024 Author(s). This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY 4.0), permitting distribution and reproduction in any medium, provided the original work is cited.

Abstract: As one of the first coastal open cities in China, Yantai City is situated in the eastern Shandong Peninsula, bordered by the Yellow Sea and Bohai Sea. With the continuous improvement of tourism infrastructure, public enthusiasm for tourism in Yantai has been growing. To formulate more effective tourism development policies tailored to the local context, this study examines Yantai City using a multiple linear regression model to identify the primary factors influencing domestic tourism income. Based on the findings, this paper proposes scientifically grounded and actionable strategies to further optimize the development of tourism in Yantai City.

Keywords: Tourism income; Multiple linear regression; Influencing factors

Online publication: December 23, 2024

1. Introduction

Tourism development not only stimulates local economic growth but also plays a vital role in promoting ecological sustainability and fostering the integrated development of related industries. In recent years, the tourism sector in Yantai City, Shandong Province, has entered a phase of stable growth. By 2023, the domestic tourism income of Yantai City had reached 101.188 billion Chinese yuan, with domestic tourist arrivals recorded at 8.79 million.

To further refine tourism development strategies and enhance Yantai's tourism revenue, this study investigates the key factors influencing tourism income. The analysis identifies existing shortcomings in Yantai's tourism industry and proposes optimization strategies to address them, aiming to ensure sustainable and efficient tourism growth.

2. Tourism revenue impact factor analysis

2.1. Analysis of theoretical factors

2.1.1. Gross domestic product

In recent years, Yantai's gross domestic product (GDP) has been on the rise. According to data released by the city's Bureau of Statistics, the GDP for 2021 was 871.175 billion yuan, with the city surpassing the 800 billion yuan mark for the first time. As the economic level directly impacts tourism income, the sustained growth of Yantai's economy is expected to drive an increase in tourism revenue. This suggests that GDP not only reflects the regional economic level but is also an important indicator of regional tourism income. Typically, the higher the GDP of a region, the higher its tourism income will be ^[1]. Therefore, GDP is one of the key factors influencing domestic tourism income.

2.1.2. Per capita disposable income

Per capita disposable income, often referred to as residents' disposable income in practice, is considered a crucial factor influencing national (or regional) consumption expenditure ^[2,3]. Since tourism consumption is categorized as a high-level demand, residents must have sufficient disposable income to support tourism spending. If residents' income is low, it becomes difficult to sustain tourism consumption. In Yantai, both urban and rural disposable incomes have continued to grow, which has a significant impact on tourism revenue. Generally, the higher the disposable income of tourists, the greater their spending during trips, thereby increasing local tourism revenue.

2.1.3. Number of domestic tourists

There has long been a relationship between tourism revenue and the number of tourists ^[4]. Typically, as the number of tourists increases, tourism revenue also rises. For instance, the number of domestic tourists in Yantai grew from 70.9357 million in 2017 to 80.0134 million in 2018. Correspondingly, tourism revenue increased from 96.145 billion yuan to 108.168 billion yuan. As the regional economy continues to grow steadily and citizens' consumption habits change, more and more people are choosing tourism as a preferred activity ^[5].

2.2. Quantitative analysis of influencing factors of tourism income

As a prominent tourism destination in Shandong, Yantai's tourism income is influenced by many factors. After reviewing domestic and international research literature and excluding variables that cannot be quantitatively analyzed, the following indicators were selected as explanatory variables for the analysis: the number of domestic tourists, the per capita disposable income of urban and rural residents, and domestic tourism income. Multiple linear regression analysis was then applied.

Let Y_i represent the dependent variable, which is Yantai's domestic tourism income. The explanatory variables are as follows:

- (1) X_1 : The number of domestic tourists.
- (2) X_2 : The per capita annual disposable income of urban residents.
- (3) X_3 : The per capita annual disposable income of rural residents.

3. Multiple linear regression model

3.1. Principle of multiple linear regression model

Assume that the multiple linear regression model for the dependent variable Y and each explanatory variable $X_i (i=1, 2, \dots, m)$ is as follows:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_m X_m + \varepsilon \quad (1)$$

where ε is the random disturbance term and $\beta_i (i = 1, 2, \dots, m)$ are the parameters to be estimated. By substituting each observed value into **Equation (1)**, the following system of equations is obtained:

$$\begin{aligned} Y_1 &= \beta_0 + \beta_1 X_{11} + \beta_2 X_{12} + \dots + \beta_m X_{1m} + \varepsilon_1 \\ Y_2 &= \beta_0 + \beta_1 X_{21} + \beta_2 X_{22} + \dots + \beta_m X_{2m} + \varepsilon_2 \end{aligned} \quad (2)$$

⋮

$$Y_k = \beta_0 + \beta_1 X_{k1} + \beta_2 X_{k2} + \dots + \beta_m X_{km} + \varepsilon_k$$

To convert **Equation (2)** into matrix form:

$$Y = X\beta + \varepsilon \quad (3)$$

$$\text{where } Y = \begin{bmatrix} Y_1 \\ Y_2 \\ \vdots \\ Y_k \end{bmatrix}, \beta = \begin{bmatrix} \beta_1 \\ \beta_2 \\ \vdots \\ \beta_k \end{bmatrix}, X = \begin{bmatrix} 1 & X_{11} & X_{12} & \dots & X_{1m} \\ 1 & X_{21} & X_{22} & \dots & X_{2m} \\ \vdots & \vdots & \vdots & \vdots & \vdots \\ 1 & X_{k1} & X_{k2} & \dots & X_{km} \end{bmatrix}, \text{ and } \varepsilon = \begin{bmatrix} \varepsilon_1 \\ \varepsilon_2 \\ \vdots \\ \varepsilon_k \end{bmatrix}.$$

3.2. Multiple linear regression model test

3.2.1. Goodness-of-fit test

For the parameters estimated by the model, the degree of fit between the predicted and observed values can be verified through the goodness-of-fit test^[6]. This method assesses the fit by calculating the goodness-of-fit value, which ranges between 0 and 1. The closer the value is to 1, the better the fit.

The total sum of squares (TSS) is expressed as:

$$TSS = \sum (Y_i - \bar{Y})^2 \quad (4)$$

The regression sum of squares (ESS) is expressed as:

$$ESS = \sum (\hat{Y}_i - \bar{Y})^2 \quad (5)$$

The residual sum of squares (RSS) is expressed as:

$$RSS = \sum (Y_i - \hat{Y}_i)^2 \quad (6)$$

The goodness-of-fit is calculated as:

$$R^2 = \frac{ESS}{TSS} = 1 - \frac{RSS}{TSS} \quad (7)$$

3.2.2. Overall significance test

The F-test is used to test whether there is an overall significant linear relationship between the explanatory variables and the dependent variable in the model^[7]. The F-statistic is calculated as follows:

$$F = \frac{ESS/m}{RSS/(k-m-1)} \sim F(m, k-m-1) \quad (8)$$

At a given significance level, the critical value can be obtained from a statistical table. If the calculated F-statistic is greater than the critical value, the model passes the significance test; otherwise, it fails.

3.2.3. Significance test of variables

The t-test is used to assess the significant linear relationship between individual variables and the dependent variable^[8]. The process for testing the significance of a single variable is as follows:

$$W = \begin{bmatrix} X_{11} & X_{12} & \cdots & X_{1m} \\ X_{21} & X_{22} & \cdots & X_{2m} \\ \vdots & \vdots & \vdots & \vdots \\ X_{k1} & X_{k2} & \cdots & X_{km} \end{bmatrix} \quad (9)$$

$$C = (W^T W)^{-1} \quad (10)$$

$$\hat{\sigma}^2 = \frac{RSS}{k-m-1} \quad (11)$$

The *t*-statistic is constructed as:

$$t = \frac{\hat{\beta}_i - \beta_i}{\hat{\sigma}^2 \sqrt{C_{ii}}} \quad (12)$$

Where C_{ii} is the first element on the main diagonal of the matrix *C*. At a given significance level, the critical value can be obtained from a statistical table. If the absolute value of the *t*-statistic is greater than the critical value, the linear relationship between the variable and the dependent variable is significant.

4. Empirical analysis

4.1. Index selection

The factors affecting Yantai tourism revenues from 2014 to 2023 were analyzed using a multiple linear regression model as follows:

$$Y_t = \beta_0 + \beta_1 X_{1t} + \beta_2 X_{2t} + \beta_3 X_{3t} + \mu_t \quad (13)$$

where Y_t represents Yantai tourism revenue in year *t*, X_{1t} is the number of domestic tourists in year *t*, X_{2t} is the urban per capita annual disposable income in year *t*, X_{3t} is the rural per capita annual disposable income in year *t*, β_0 , β_1 , β_2 , and β_3 are the parameters to be estimated, and μ_t is the random perturbation term.

4.2. Data source

This study uses tourism-related statistics for Yantai City from 2014 to 2023, sourced from the Statistical Yearbook of Yantai City, as shown in **Table 1**.

4.3. Analysis of software implementation results

EViews software was used to perform regression analysis on the tourism-related data of Yantai. The results are presented in **Table 2**. The model fitting can be determined from the fixed coefficient and the adjusted coefficient of determination. The value of $R^2 = 0.975$ and the adjusted $R^2 = 0.96$, both of which are close to 1, indicating a good fit.

Table 1. Yantai tourism-related statistical data (2014–2023)

Year	Domestic tourism revenue (100 million yuan)	Number of domestic tourists (ten thousand people)	Urban per capita annual disposable income (yuan)	Rural per capita annual disposable income (yuan)
2014	614.10	5,426.90	33,302.77	14,269.61
2015	698.46	5,942.33	35,907.33	15,540.23
2016	839.00	6,448.32	38,743.97	16,720.85
2017	961.45	7,093.57	41,837.11	18,050.62
2018	1,081.68	8,001.34	44,874.85	19,425.26
2019	1,148.50	8,624.41	47,977.00	21,218.00
2020	624.40	5,337.90	49,434.00	22,305.00
2021	859.16	6,501.21	53,169.00	24,574.00
2022	637.31	5,310.42	55,700.00	26,286.00
2023	1,011.88	8,790.10	59,126.00	28,349.00

Table 2. Descriptive statistics

Model	R	R ²	Adjusted R ²	Standard error of skewness	Dubin-Watson
1	0.987	0.975	0.96	-	2.251459

The Durbin-Watson statistic typically ranges from 0 to 4. A value near 2 indicates that the residuals are independent of each other. If the number of independent variables is less than 4, and the Durbin-Watson statistic exceeds 2, it suggests that the residuals are independent. In this case, the Durbin-Watson value of 2.251459 is close to 2, and since the model contains 3 to 4 independent variables, the residuals are considered independent.

Table 3. Variance analysis

Model	Sum of squares	Df	F	Saliency
Regression	39.61468	3	73.67951	0.000b
Residuals	9415.936	6		
Total	9455.55068	9		

From **Table 3**, the F-value is 73.67951. With a significance level of 0.05, the critical value from the F-distribution table is $F_{0.05}(3,6) = 4.76$. Since $F = 73.67951 > 4.76$, the regression equation is statistically significant.

Table 4. Regression coefficient

	Coefficients	Standard error	t-value
Constant term	-11.72244	2.983866	-3.928606
	1.048970	0.101823	10.30193
	3.764643	1.277043	2.945589
	-3.139013	1.052091	-2.983594

In Table 4, the t-values for the logarithmic transformations of X_1 , X_2 , and X_3 are compared with the critical values. Since each t-value exceeds the critical value, each explanatory variable passes the t-test. Therefore, the multiple linear regression model for Yantai tourism income is expressed as follows:

5. Conclusions and suggestions

Based on the results of the multiple linear regression analysis, among the three explanatory variables, the variable with the greatest impact on domestic tourism income is urban per capita annual disposable income. In comparison, the number of domestic tourists and rural per capita annual disposable income have a smaller impact on Yantai City's domestic tourism income. With the continued economic development of Yantai City, the increase in per capita disposable income, and the rise in domestic tourists, the domestic tourism income of Yantai City is expected to continue growing^[9].

In light of the above analysis, the following suggestions are offered to promote the sustainable development of tourism in Yantai:

Firstly, the regression analysis results show that the annual per capita disposable income in Yantai City has a significant impact on domestic tourism income. Therefore, efforts should be made to strengthen the publicity and promotion of tourism among urban residents. Additionally, nearby tourist attractions in urban areas should be developed to encourage more urban residents to travel^[10]. While rural per capita annual disposable income has a relatively smaller effect on tourism income compared to urban areas, it remains important to implement measures to improve rural income levels. This can be achieved by narrowing the income gap between urban and rural areas, reasonably utilizing the ecological resources of rural environments, and fostering rural tourism development. Furthermore, the government should pay special attention to the tourism development of towns and rural areas, providing policy support and resources, and establishing efficient governance models^[11]. Developing distinctive tourism projects will attract tourists and stimulate consumption. This strategy will not only promote the diversification of Yantai's economy but also offer more leisure opportunities for both urban and rural residents, thus achieving mutual benefits and fostering urban-rural cooperation.

Secondly, given the close relationship between economic growth and tourism development, Yantai must continually promote economic improvements to raise per capita disposable income and increase investment in tourism consumption. To this end, the government should prioritize the optimization of the industrial structure and the enhancement of economic benefits^[12]. Promoting sustained economic growth will create more job opportunities^[13], which will lead to an increase in residents' disposable income and expand the financial capacity for tourism consumption. This, in turn, will further promote the development of tourism in Yantai.

Thirdly, the development of the tourism industry is not an independent process. It is essential to actively explore the integration of culture and tourism to promote the sustainable development of the sector. Under the "Hospitality Shandong" initiative in Shandong Province, Yantai can leverage its coastal attractions to enhance its tourism offerings. However, the city's tourism income still relies primarily on domestic tourists, and its international influence remains limited. To foster greater growth in the tourism industry, Yantai should create iconic tourism products and increase awareness of local customs and traditions. Expanding international market channels and attracting more tourists will contribute to the city's tourism development. Furthermore, Yantai should fully utilize e-commerce platforms, actively exploring the potential of tourism e-commerce and employing online platforms for marketing. Finally, continuous innovation in tourism development ideas and

proactive exploration of tourism markets will help ensure the sustainable development of tourism in Yantai.

Disclosure statement

The authors declare no conflict of interest.

References

- [1] Zuo B, 2011, Analysis on Factors and Contribution of Tourism Economic Growth in China. *J Bus Econ Manag*, 2011(10): 82–90.
- [2] Chen H, 2016, The Influence Factors of Economic Development in Shandong Province Based on the Multiple Linear Regression Analysis. *Res Financ Educ*, 29(5): 65–69.
- [3] Zhang Y, Jiang YY, 2022, The Games are the Creation of the Heritage Tourism, Identification, and Utilization. *J Travel*, 37(1): 13–15.
- [4] Chen YY, 2022, High-Quality Development of Tourism Cities in the New Era: Connotation and Path. *Tour Trib*, 37(2): 12–13.
- [5] Hao Q, 2014, Based on SPSS Analysis of Urban and Rural Residents' Per Capita Disposable Income of the Impact of Domestic Tourism. *Shandong Text Econ*, 5: 15–17.
- [6] Hu J, Huang Z, Ni Y, 2024, Econometric Analysis Under the Perspective of the Domestic Tourist Income Influence Factors and Development Dynamics Study. *Ind Innov Res*, 2024(9): 8–10.
- [7] Liu H, Ruan D, 2024, An Analysis of the Influencing Factors of Tourism Economic Development in Hubei Province Based on Econometric Model. *Bus Exhib Econ*, 2024(8): 158–162.
- [8] Zhao Y, 2023, Cooperative Economics & Technology. *Coop Econ Technol*, 2023(6): 22–25.
- [9] Yu F, Huang Z, Fang Y, 2013, Characteristics and Influencing Factors of Rural Residents' Tourism Consumption in China. *Geogr Res*, 32(8): 1565–1576.
- [10] Zhang Q, Zhang Y, Zhang SB, 2016, Research on Comprehensive Performance Evaluation Index Based on Multiple Linear Analysis. *Mod Bus*, 5: 22–24.
- [11] Yuan JP, Qiu JG, 2024, Research on the Integrated Development Path of “Sports, Tourism, and Agriculture” in Yantai City Under the Strategy of Rural Revitalization. *Agric Outlook*, 20(3): 90–95.
- [12] Tang Q, Sun J, 2024, Mechanism and Path of New Quality Productivity Promoting Coordinated Development Between Urban and Rural Areas. *Hunan Soc Sci*, 2024(3): 31–40.
- [13] Wang Y, 2018, Research on the Relationship Between Tourism Economic Development and Employment Effect. *Market Res*, 2018(5): 45–47.
- [14] Cao F, Li R, Gao X, 2023, Analysis and Research on Yantai Cultural Tourism Market. *Mod Comm*, 2023(18): 49–52.
- [15] He W, 2023, Investment Prospects and Strategies of the Tourism Industry in the New Era. *West Tour*, 2023(11): 103–105.

Publisher's note

Bio-Byword Scientific Publishing remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.